uto Sense

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AUTO SENSE

By JAMES R. WRIGHT.

The world had it's Ox age, then it's Horse age, and now is the Auto age.

In the Ox age whoever had ox sense could successfully drive a yoke of oxen, in the Horse age one with horse sense could drive a team and, now in the Auto age, why shouldn't any person having Auto Sense successfully handle a motor car?

Now the only way any one came to have ox or horse sense was by intimate acquaintance with those domesticated animals and, just so, if one acquires Auto Sense he or she must become intimately acquainted with the automobile.

No—Never mind what other folks say, or think, you do not need a Complete Course in Automobile Engineering, for that is as unnecessary as that you should be a veterinary in order to drive a team of horses.

What you want is to know your car like you knew your old family horse.

The real pleasure of owning and driving a car consists simply in having Auto Sense.

Really, there are no spooks to hurt you, and if you will trust yourself with me I will tell you all the secrets of science involved in the operation of an automobile.

I will put these mechanical "mysteries" in such simple, easy terms that you will laugh at yourself for having ever thought an automobile a hidden maze of tangled complications and your car will stand out before your mind as a beautiful pleasure boat, like those magic chariots the fairies use to drive with their musical wands.

It is true, the automobile is the product of the cumulative genius of the auto age and was conceived, developed and perfected by master minds but, God made the old family horse and you did not imagine, in the smallest degree, you should know as much as the Creator to master perfectly the work of His hands.

Now let us suppose that your automobile, of whatever make or model, has come to you for your care and keeping and to serve you, in exchange for your faithful family hores.

If you may have as much Auto Sense as you surely had horse sense you will be delighted with your car and then, when any one wishes to sell you a "fool-proof" machine, you will feel insulted that they take you for a fool. Suppose some one should try to sell you a horse on the recommendation that he was "fool-proof," and yet one may never hope to under-

stand the horse half so well as one may an automobile.

Now let us go out to your garage where stands your car, just where your gentle, obedient horse was once wont to stand. O, I see—you have rebuilt somewhat—Yes, and put in a concrete floor.

What a beautiful car you have; such lovely and striking colors, and how charmingly attractive the body lines.

You say you have driven it only a few miles since your son went away? And you don't know if you will ever try it again! You had trouble and had to be pulled in! And then got it started and had an accident, and drove through a closed gate! How strange.

Did you ever have to be pulled in by another when you drove your old family horse? You say, Only when you were drunk, other times the horse minded you.

Did you ever drive your horse through a closed gate? You say, Not when you were sober. O yes, of course, he minded you and you could control him, but why not control your car and make it mind your every command? You say the car is full of trigger works and machinery that you cannot understand. Now listen. You know why a grind stone has grit, why a knife has an edge, why a spade has a handle, why a door has a knob and why a lock has a key. You knew why your horse had feet and limbs, why

he had a body, why he was provided with eyes and ears and why it was necessary that he should have a stomach and lungs and heart, just so, when you have Auto Sense you will easily see the reason and use of all the parts of your car.

Now we will presume, in the first case, that your car is equipped with a self starter, and I will take the wheel till we are well on the road, then we will finish with yourself at the wheel.

We will presume that you understand the simple procedure of how to start your engine. What! The starter will not start, will not turn the engine over. (This system the author is using, you may call Instructive Presumption, that is, it is presuming a situation, condition or thing for the sake of introducing or suggesting instruction.)

What shall we do? Call up the city garage, you say. Oh no, let us have Auto Sense.

Now there are just Seven Causes of failure in any self starter and one or more of these causes is responsible for our trouble, but never all of them at one time. A man may have one or more kinds of prysical derangement but he will never have every thing in the world at once. Will he? Well, the starter will not start. Let's shoot the trouble.

Now listen: in trouble shooting never try to guess the cause, as that method is not sense but it is the most stupid ignorance. You had as well guess two things and pitch up a coin and let heads or tails de-

cide which of the two is right. I said—, What did I say? That's it. I said in a Starter failure there are just Seven Causes of trouble to investigate. How shall we begin? If you had seven possible causes of any given trouble to discover wouldn't you look first for the most probable one of the seven? Exactly so. I know you get my idea clearly.

The first probable cause of failure in this case now before us in A Weak Battery. (Let the reader here turn to, and carefully read, Article 1, on Testing Batteries.)

Suppose we find our battery down or discharged then, of course, the Starter will not start, since it's only source of energy is from the battery.

But suppose we find the battery up and O. K. then the next and Second most probable cause of failure is an Open Circuit. (Here turn to Article 2, on Inspecting Wiring and Switches and read the author's instructions.)

Now we must remember that electricity flows under control over wires or conductors as water flows through pipes or conductors and if our Starter was a water motor and our battery the pressure supply and we should break or otherwise disconnect a pipe we should have a dead Starter. So we will inspect the wires, the switch contacts and the terminals or brushes.

If we find no open circuit then the next and Third most probable cause of our trouble is A Ground or

Short Circuit. Electricity, like water, will follow the line of least resistance and wires or switches may be providing the circuit with a ground contact.

If we find no grounds or short circuits then the next and Fourth most probable cause would be Faulty Brushes. They may be worn out, or stuck in the holders, or the springs may not be in condition to press them firmly against commutator.

But suppose we find the brushes O. K. then we proceed to the Fifth probable cause, A Rough and Dirty Commutator. Of course we will clean this part if it is dirty and smooth it with 00 sand paper.

Now if we have found the trouble in any one or more of the five mentioned causes then we can correct the trouble and have thus saved a heavy garage bill.

But if we yet fail to find the trouble we shall have to call the garage or crank by hand power as the two remaining causes of failure in our Starter are highly technical and require the service of an expert. We have a Grounded or Defective Armature or Field Windings, or we have High Resistance in Main Circuits.

If the last named cause was from loose terminals, bad joints, poor switch contacts, rough commutator or short brushes without sufficient spring tension, then we might easily correct it, but it may result from too small wire being used and of this we will not presume to judge.

But we have at least eliminated Five of the first and most probable causes of Starter trouble and, with rare exceptions, we have made the Starter Start.

NOTE. Generator Troubles may be located and corrected by the same steps of procedure as outlined on the Starter troubles with the further exception, the relay cut out switch located in the system between the Generator and Battery may require the attention of an expert.

We will now suppose that the Starter spins the engine, (If your car is not equipped with a starter we will then suppose that you spin the engine with the hand crank.) Of course, ordinarily, your engine starts at first cranking but, since we are to learn what to do in the event it fails to start, we will presume that it does not start.

Now if you are listening to what I am saying it will save you sweat, profanity and "everything."

If an engine fails to start on any reasonable cranking then you had as well quit that foolishness. You will exhaust your battery if you are using a starter, or you will exhaust yourself if you are cranking by hand. If the engine fails to start on reasonable cranking it is evident proof that sometnihg is wrong.

Now right here we must get our mental bearing, for if we go to floundering around with excited haste, we may really get this engine "out o' fix." You have heard of the fellow who, when his engine quit, tore it all to pieces and scattered it over the barn yard

and then wisely concluded that, from stem to stern, he had failed to find a single thing wrong with it. He then called a garage. The expert came and was asked to see if he could find any reason why the engine wouldn't start. The expert angerly told the car owner to never again try to shoot engine trouble with a manure spreader.

We will be strengthened in our confidence if we know what is not wrong with our engine. You say, A hundred things might be wrong. Oh no, that is not possible, but that false idea is the reason why so few people can shoot auto trouble.

Suppose you have lost a piece of silver coin and you are going to hunt for it, what are you going to look for? A piece of silver coin. Exactly so. It is a definite, positive something you are going to look for.

Now there are just Twelve causes, and no more, of the trouble in our engine failing to start at reasonable cranking. Listen: It is highly improbable that more than one of the twelve is to blame in any given case, that is, that more than one at a time may develop.

Please do not think me offering an insult to your intelligence when the first causes of frequent engine trouble are cited.

First, let us see that gears are not engaged, that the clutch is fully thrown out and that the gear lever is in neutral.

If you have observed as closely as the author you have known garage bills to accrue at No. 1.

Second, let us see that the switch is turned to starting position. Don't laugh. Yes, you could cite several cases. So could I.

Third, let us see if there is sufficient gasoline. Plenty in the tank. Alright, then open the drain cock on the carbureter and see if it flows freely. If it does, very well. If it does not, then we have a fuel stoppage. If our car has a gravity feed we will examine, first, the vent hole in the top of the filler cap, to see if any leaf, or paper, or dirt, or other stray fragment of any thing has stopped it up. If we find it open and clear of obstruction, next we will open the drain cock at the bottom of the sediment trap on the lower side of the gasoline tank, (Or wherever it may be located) and we will run a wire up into the trap to loosen and release any obstructions which may be lodged in the fuel outlet, (leaving the drain cock on the carbureter open to test for flow of gasoline. If we yet fail to get desired results we will next disconnect the fuel pipe line from the carbureter and with our tire pump we will pump air through the pipe. If fuel then flows, alright, connect the pipe again. If fuel already flows when we first disconnect close the line at the shut off valve next to tank and pump air through carbureter. If we still fail to secure free flow of fuel through carbureter then we must remove and disassemble carbureter and we will now finally remove any and all obstructions. Therefore this trouble is corrected.

But if our car has a pressure feed system, then we must look for sufficient pressure in the tank, and if pressure is insufficient, we must look for leaking tank, or piping, or filling cap, or stuck relief valve, or for clogged piping.

If our fuel system should be the Vacuum feed, then we must look for trouble, most usually, in the chamber of our vacuum system. There may be sediment under the trap valve between the vacuum chamber and the carbureter supply chamber, a spring may be broken, a valve may be stuck or faulty, it may have lost its priming. Suck hard on the overflow pipe and if that fails put your tire pump hose connection over the vent hole in the filler cap on top of the gasoline tank and pump till the gasoline flows from the overflow pipe on top of the vacuum tank. This little trick will usually dislodge any sediment which may have gathered under the valve in the vacuum chamber.

But suppose we found plenty of gasoline flowing from the carbureter when we first opened the drain cock to test for fuel, then we would not give one other thought to our fuel, but would look elsewhere for the trouble.

Fourth, we will test for flooded engine. Switch off the ignition. Do not use the chocker. Never mind your throttle position. Spin the engine, or, at least turn it over a few times. Switch on the ignition and spin the engine.

If the engine still refuses to start after we are sure we have cleared the cylinders of excessive gasoline, we are ready for another definite step.

Fifth, we will test the battery to see if it is run down, discharged or exhausted. (The reader should thoroughly familiarize himself or herself on testing batteries. See Article 1.)

If we find the battery O. K. let us not make the frequent mistake of jumping a cog here in our system. We are taking up trouble in the order, remember, in which we are most apt to find it.

Sixth, we will adjust the carbureter to normal mixture. (Let the reader here study carefully Article 8, on Testing Gasoline and Adjusting Carbureters.)

Some inexperienced person may have tampered with our carbureter, or it may have jolted out of proper adjustment and would yet function when our engine was heated up.

If the weather is cold our mixture may be too lean to start the cold engine. One minute should be ample time, let us adjust it. And yet our engine does not start.

Seventh, let us now inspect for broken electrical circuit.

Oh no, here is not where we call the garage, I blundered in using the term, Electrical Circuit, and that stumped you. May I kill that mystery with one simple suggestion. You can neither see the air nor

your lungs yet you are easily and quickly able to know if your lungs are not getting sufficient air. (Here the reader sohuld refer to the Article 2, on Inspecting Wiring and Switches.)

Recall what was said while we were shooting trouble on our Starter in the comparison we made of water pipes and wires. Suppose we take a child's toy train for an illustration. We have a circular track. Wind up the engine. Now it runs around the circle and comes back to us. We wound the spring on the tiny locomotive. We are the source of its energy. We sent it forth on a circular track and it returned to us. Now we will remove a section of the track and oh, of course, it "jumps" the track and does not return. Why? Because its circuit is broken. This is just play to shoot trouble. Electricity is our toy. The battery, or magneto, or dynamo winds our toy up and the wires and conductors are the little tracks on which it runs. So if something has broken or otherwise rendered our track defective then our toy, like the little tin locomotive, will "jump" the track only, in the case of electricity, our toy stops on the end of the broken track, unless it is helped off by a ground wire or conductor. So if we find no broken circuit we will next look for:

Eighth, an interrupted electrical circuit. Now don't let your mind get balled up on this term. It simply means that the "Cow-catcher" of our tin toy has run into something on the track and the thing has interfered with our "locomotive" and it fails to make the complete circuit of the track. (Here the

reader should consult Article 4, on Inspecting, Testing and Adjusting Vibrators and Coils. Also Article 6, on Inspecting and Adjusting Circuitbreaker or Interrupter.)

We will inspect all ground wire connections and look for ground connections, or a short circuit from lack of insulation, or defective wiring.

If our car happens to be a Ford, which is frequently the case, then we must look for lint or waste on the point of the magneto current collecting contact plunger. Now don't let this name mislead you and cause you to look for a submarine or something worse. It is the magneto binding post located under the toe board. Take out the three screws and lift the plunger out and inspect it.

(Read Article 3, on Inspecting and Testing Magnetos and Dynamos.)

If we still have a dead engine we will proceed:

Ninth, to inspect for fouled or cracked electrodes of spark-plugs. (Here read Article 7, on Inspecting and Adjusting Spark Plug Gaps.)

Any trouble here will, on inspection, plainly manifest itself and be easily corrected.

Tenth, if our engine yet fails us we will look for faulty compression. (Let the reader here study the Article 5, on Timing and Article 9, on Adjusting Valve Lift.)

We must test for compression and we must not mistake mechanical resistance, when cranking by hand, for compression. If we may have a compressometer each cylinder should show from forty to sixty pounds, at hand cranking. If there is perceptable resistance to hand cranking from compression there is at least twenty pounds. The engine should crank, therefore faulty compression is not to blame. But if there is no perceptible resistance from compression at cranking then we may find the piston rings gummed, or stuck, or turned with openings or slots in line. A valve head or seat may be warped, or incorrect timing or lift may cause leakage. We must be sure that no spark plug core leaks compression. We must look for dry cylinders and see that there is sufficient supply of cylinder oil. We must look for defective cylinder head gasket and for leaks around the cylinder head cap screws. We must look for any possible leak around the fittings of the intake manifold or for any sand holes in the manifold itself. We must look for stuck inlet valves and see if valve push rods are adjusted to allow the valves to seat properly. We must see if the valve springs are weak or broken.

Now after having inspected, tested out and systematically overhauled the distinct components of each distinct group of the entire power plant, advancing by steps, until we have completed the full investigation of Ten causes of failure when an engine will not start, if our engine still fails us we must call the garage for the reason that the Two remaining

causes of failure are of an electrical nature involving our magneto or coils in a way that it will, in all probability, require an expert to make the repair. They are either a burned or broken down winding or a demagnetized field.

Of course, there are other minor things, either electrically or mechanically, involved when a gas engine will not start, but they lie within the zones of inspection outlined and will, in all probability, be apparent to the careful observer.

It will seldom occur that even two causes of engine trouble shall develop at the same time, and especially is this true if an engine has had due attention.

It should be remembered that the two points, 11 and 12, on which we stuck and called the garage are very rare occurrences and might not happen once in the life of a car.

Therefore we may justly claim that we found the trouble, corrected it and Started the engine.

We will now suppose we crank the engine and it starts each time it is cranked but immediately stops.

Now be patient and sensible and don't consign it to the scrap pile or knock on the make of the engine or "cuss' the factory that put it out. Just simply have Auto Sense.

Now this is a different class of trouble from what we had when our engine would not start. There is

presented to us evidence of a fault somewhere and it's up to us to locate it and correct it.

Now if we would be quick and efficient trouble shooters we must classify our troubles and systematize our line of procedure.

We had first, a case of starting a dead Starter and we considered only such things as were directly responsible for that class of trouble, then we had a case of starting a dead engine and we specialized on those things immediately causing that class of trouble, and now we are to correct the fault of engine stoppage and therefore a new and different class of trouble is before us.

In this case there are just Eight causes to investigate.

First, and always first in this case, we will see if we have sufficient gasoline supply. If the fuel supply is O. K. and getting through the carbureter very well, but we must be sure that the fuel line is absolutely clear of all obstructions, for the reason that this is the most frequent cause of engine stoppage. If there is a fuel obstruction any where from the tank to the intake manifold we shall have trouble.

Second, we will look for insufficient spark. We may be getting a spark at the sparking time of each plug, but it may be weak. We must test our batteries and thoroughly inspect the source of our electrical energy. This may be easily and quickly done. If our spark is weak it will show weak, if strong, it

will show strong. We can tell a shooting star from a lightning bug. Can't we? Sure.

Third, we will inspect the switch. We must take the switch off and take it to pieces if need be and overhaul it till we know it is not to blame for our trouble, but listen: just remove one thing at a time and note how it comes from the assembly and then put it back just like it should be and then take another and so on till you have overhauled the functioning parts of the switch.

Fourth, we will see if we have a broken electrical circuit. We shall simply have to become familiar with these "Circuit' 'troubles and the author is trying to hand it to you in "broken doses" or "on the installment plan" so you will quit shying from this electrical "scare-crow."

Recall the water pipe illustration, and the tin locomotive. Now you know what a circus is. Yes, a show that shows in a ring, or it may be a big "three ring" circus.

An electrical circuit is simply a flow of electricity in a circuit, from the battery, or generator, to given points on given conductors and returning to source of flow.

There will be as much electricity return to the battery, or source of flow, as went out, except what is absorbed by the resistance it encounters in its circuit. Resistance overcome is called work and is measured in watts.

The pressure which your battery provides is called volts and the quantity of flow is called current or amperage, that is, these are terms used to measure electricity.

Now suppose we have a broken wire and its position in the holder or support is such that without shaking it there is contact with the two broken ends, but with the shaking consequent to the running of the engine, the ends open at the brake in the wire, that is just the same as switching off your ignition. The circuit is broken. And we must remember that a loose terminal, when the engine is shaking the wire may not make sufficient contact to close the circuit, therefore our engine will stop.

Fifth, we may have a coil vibrator blade stuck.

Where a single coil is used for each cylinder, as in the Ford ignition system, this trouble would not stop our engine as it is highly improbable that all the vibrator blades would stick at once, but if we have only one coil acting for the whole system then the failure of that coil would stop our engine. (Here in this connection read carefully Article 4, on Testing, Inspecting and Adjusting Vibrators and Coils.)

Sixth, we will see if we have poor cotnact in timer.

Let us not be afraid to remove the timer and clean it and inspect it. If we find poor contact we must correct it and if any part, or the whole assembly, should be replaced we can easily attend to it ourselves.

Seventh, we will look for faulty carbureter adjustment.

We will presume you have read Article 8, on Carbureter Adjustment and can properly adjust your own carbureter.

Eighth and finally, we will look for a leak in the intake manifold. To test for a leaky manifold we put some gasoline in an ordinary oil can and start the engine and at once, while the engine runs, we squirt gasoline over the manifold. If it picks up or suddenly dies from the operation it is positive proof of a leaking manifold.

It should be remembered that there are rare causes of engine stoppage which the author has not dealt with but they may never occur in the life of a car and would require the attention of an expert in the event they should develop. If we fail to find the trouble in any of the eight zones of inspection set down we should call the garage. If our car is a Ford, one of the unmentioned causes of engine stoppage is a worn main bearing permitting the coils or magnets to touch or lock.

I may be pardoned for this suggestion, however, if you will give the running condition of your car due attention it will be a rare exception if you ever have any engine stoppage from any other causes than those we have gone over.

Now we will presume we are taking another start.

The engine runs fine if we drive along slowly, but if we attempt any speed it misses.

There are Five causes for that kind of engine performance.

First we will see if we have a faulty carbureter adjustment. Let us inspect and test out our carbureter for the best possible adjustment.

Second, let us see if we have a worn timer. This cause seldom fails to develop a miss at high speeds. If we find our timer worn we should replace it with a new one.

Third, we will look for a weak or run down battery. High speeds develop heavier compression and consequently the current meets with greater resistance at the spark plug gaps, then too, the high speed requires the more rapid flow of electrical energy to maintain sparking pressure of the electricity, consequently a weak battery quits the job at high speeds.

If there is a short in the magneto of a car using magneto ignition the high speed may put the peak of electrical pressure so high in the mag. that the system is short shortcircuited. If the magneto is weak the engine will miss at high speeds. If our car is a Ford, there may be lint or waste shreds or particles of fabric from the brakeband on magneto current collecting plunger, located under toe board. Remove the plunger and clean. Also in a Ford the timer case may not be making proper contact with engine.

Fourth, we will look for faulty vibrator adjustment. (Consult Article 4, on Adjusting Vibrators.)

Fifth, we will inspect the fuel pipes and passages to see if they are obstructed. Here recall how we overhauled the fuel system when our engine would not start.

There are some other highly technical reasons why an engine may miss at high speeds but, in both theory and practice, we have considered the causes most apt to occur. When these five causes of a miss at high speeds have been eliminated from all cars not one car in ten thousand will show any high speed miss.

Now we will suppose our engine to speed up nicely and run well except it develops an occasional and irregular miss. This miss, we will find, will occur at any speed or under any road conditions. Now all cylinders hit regularly, then again there is a miss, and so on.

The reader should remember that a miss of this class or character may put an engine entirely out of commission, so far as service is concerned, although the engine may crank and give occasional promise of acting O. K.

Now we have Ten possible causes to investigate and we must not for a moment presume that all of the causes involved in our investigation are in any one case responsible for our trouble.

First, we will inspect our timer and see if it is

slipping and if so, reset it and tighten. Now it is plain if our timer is not making proper rotation as set and timed for ignition we should have the very kind of trouble we have mentioned. It must be regularly and continuously distributing to each cylinder the electrical energy in the firing time of the cylinder. If our timer has slipped on the rotating shaft it throws our firing out of time. If our engine is a Ford, we must inspect the Roter, (This is the little castor shaped roller on the end of the rotating shaft under the timer case, or cover.) for a broken or defective spring or for a slipped or otherwise misattached roter.

Second, we will see if our half-time shaft is loose.

This may be the cause of our trouble and we had as well inspect for this and then we will know if it is, or is not to blame. Of course, if we find this shaft loose we will set it in proper time and fasten it to place.

Third, the air valve on our carbureter may be sticking and we should inspect this valve and be absolutely certain that it is free and properly functioning.

Fourth, there may be an intermittent obstruction in the spray nozel. We should test for a clear and free flow passage for our fuel so the engine will be provided with a constant mixture.

Fifth, we must inspect to see if either an inlet or an exhaust valve is sticking as this, in either case,

would instantly cause the kind of trouble we are dealing with.

Sixth, we must inspect for a broken or weak valve spring.

(To test a valve spring for weakness, we push a screw driver blade between the coil turns of the spring while the engine is running. If the engine picks up perceptibly, spring is weak.)

Seventh, we must look for loose connections. We will follow, in this investigation, the same lines of procedure as in former troubles in looking for loose connections.

We should read carefully Article 2, on Wiring and Switches.)

Eighth, we must look for a short circuit. Now remember that a short circuit is a case in which our electrical energy which we require for ignition finds an easier path than that of having to jump the gap in the spark plugs. We must see that the circuit is as it should be, over the appointed conductors, provided and installed for the purpose of carrying the current.

Ninth, we must look for faulty carbureter adjustment.

Always keep in mind that some one may have tampered with your carbureter, or that it may have jolted out of proper adjustment, or radical changes of weather may have put it out of adjustment re-

quired for the present prevailing weather conditions. (Consult frequently and thoroughly familiarize yourself with Article 8, on Testing Gasoline and Adjusting Carbureters.)

Tenth, we must see if we have faulty valve adjustment. (Read carefully Article 9, on Adjusting Valve Lift.)

It will be a very rare occurrence if we find more than one of the ten mentioned causes to blame in any given case, but it is possible that, that one could be the last on the list. However, we must not become impatient and run ahead of ourselves in finding the exact trouble. It should require but a few minutes to take up these ten causes in their order and quickly find our trouble.

Now that we have corrected this irregular miss we start once more and our engine suddenly develops a constant miss in one or more cylinders with the other cylinders firing regularly. Now there are only Three causes for this kind of miss. Let the reader note carefully that the author makes a clear distinction between these engine symptoms to help you from getting "bumfuzzled" in trouble shooting. The reader must keep these distinctions clear and not become confused. What is the class of engine trouble we are now considering? A constant miss in one or more cylinders, other cylinders firing regularly.

First, we will see if we have a faulty vibrator adjustment. (Note Article 4, on Testing and Adjusting Vibrators.)

Second, we will look for defective Timer. (Here reflect on the reason and purpose of a timer and read Article 5, on Inspecting Timing.) Take off your timer and inspect it. If it is dirty, clean it. If it is worn, replace it with a new one.

Third, we must look for a defect in the secondary circuit. This may or may not require a lengthy inspection.

Try to remember this simple statement: If certain cylinders are firing regularly it is proof positive that the missing cylinders can only miss from causes in the vibrator, timer or secondary circuit.

Now we will suppose that all the cylinders hit, but occasionally they all missfire. Now we must remember that this is another and distinct class of engine trouble. Don't confuse this symptom with any other trouble we have considered.

In this case we have Four causes of trouble to investigate.

First, we will see if we have fouled spark plugs. This is a simple thing but it is, in this case of engine trouble, the first most probable cause.

Second, we must inspect our gasoline supply and see that a free flow of fuel is getting to and through the carbureter.

Third, we will see if we have faulty carbureter adjustment.

The reader has, no doubt, already observed that faulty carbureter adjustment may be to blame for most any kind of engine trouble, therefore, we must take the time to inspect and adjust our carbureter.

Fourth, we will see if we have a stuck valve. We must see that valves are free in their guides, else they cannot function. We should easily find and correct this simple trouble.

Now we will suppose a case in which our engine acts "crazy" and gets on our nerves. One minute it picks up and seems to do its best and the next minute it wants to quit. It changes on us, fluctuating from good to bad and from bad to worse. There are Seven causes, any one of which may produce this kind of engine performance.

First, we will look for a cracked spark plug.

Second, we will look for a broken or defective insulation on some wire. The wire may be swinging or jolting the exposed part against some metal part thereby shorting or grounding the circuit.

Third, we will see if any wire connection is loose or broken. See that all terminals are tight on their binding posts.

Fourth, we will see if we have a poor contact in the timer. See that the timer is not loose or wabbling and that it makes proper contact for ground. Here again the author is emphasizing to you the need of careful inspection of your timer. If you

were grinding sausage and the mill or grinder choked up wouldn't you unchoke it and go right on with your grinding? Of course you would. Well a timer is just as simple as a sausage mill, so don't be foolish. Have Auto Sense as well as sausage sense, and see that the electric mill is working.

Fifth, we will see if we have faulty carbureter adjustment. You see our carbureter is still on our engine and may need attention.

Sixth, we will see if there is a leak in the intake manifold. Recall the simple way to test this, by squirting gasoline on the manifold when the engine is running and if the engine picks up or instantly dies, the manifold has a leak. In the case of a leaking manifold the author advises a new manifold.

Seventh, we will test for water in the gasoline. If extreme cold weather, this water may have frozen and we may have ice in the bottom of the gasoline tank or in the pipe line or in the carbureter.

We will now suppose another class of engine trouble. This time all the cylinders hit regularly and evenly. The engine runs smoothly and we would let it alone, but it has no power. The explosions are weak and the engine cannot pull.

Now there are only Seven reasons why an engine may not show power efficiency, when all the cylinders are hitting regularly, and we will follow a simple, but sure, system in locating the exact cause of our trouble.

First, we will inspect the coil vibrator adjustment and we should be sure it is right. (Read Article 4, on Adjusting Vibrators.)

Second, we will inspect for valve leakage. Poor compression will greatly reduce engine power.

Third, we will look for weak valve springs. Recall how to test a valve spring by inserting a screw driver blade between the coils of the spring with the engine running. If the engine picks up, spring is weak. Take the spring out and stretch it by pulling on either end, securing the other end.

Fourth, we will inspect the lift on the exhaust valves. It may be insufficient to clear the cylinders for the fresh fuel charge.

Fifth, we will see if we have faulty carbureter adjustment.

Sixth, we will inspect for faulty operation of carbureter auxiliary Air Valve. This valve must work free and seat perfectly.

Seventh, we will see if we have sufficient lubrication.

Any one of these seven causes may be the reason why an engine will not develop power.

The author has carried on extensive experimental work in his engineering laboratory and has, at least, convinced himself that the principal cause of weak explosions is due to the cylinders loading with a

heavy mixture of unvaporized gasoline. The heavier fuel we are forced to use carries such large per cent of kerosene that the average carbureter is not provided with sufficient heat to completely vaporize it.

Now we will suppose a class of engine trouble in which our engine shows great power and acceleration when the clutch is fully thrown out and the engine is running idle. The slightest opening of the throttle causes the engine to respond with promise of great power but, when the load is put on there is a sluggish, draggy action of the engine.

There are just Four causes for this kind of troubel.

First, we will inspect our brake-band adjustment. The bands may be dragging on the brake drums or "riding" in a way to absorb the power.

Second, we will inspect our clutch to see if it is slipping. A slipping clutch will absorb the power but will not transmit it.

Third, we will inspect our clutch pedal adjustment to see if we have faulty engagement of the clutch.

Fourth, we will inspect the clutch surface of our clutch to see if it is worn. A worn clutch surface will permit intermittent clutch slippage and consequently greatly reduce the power of our engine.

Now we are on the road and our engine is working fine.

We have found all of our troubles and corrected them.

This gave us confidence and we are now speeding along feeling the strong sense of mastery which comes from our success, but presently we discover another very serious trouble. Our engine is overheating. It boils and steams and smokes, and we half fear it is on fire.

There are only Eight causes which produce overheating of an engine.

First, we may have an over-retarded spark and that will seldom fail to cauase an engine to overheat. Fully advance your spark. It was designed and provided for this in the theory and practice of experts, for the reasons of keeping an engine cooler, giving it more power and securing greater economy.

Second, we will see if valves are properly timed. (Read Article 5, on Timing.)

Third, we will see if exhaust valves raise sufficiently to permit a quick escape of the exhaust gases. (Read Article 9, on Valve Lift.)

Fourth, we will inspect the muffler to see if it is clogged with carbon or soot. If clogged it will choke the exhaust passage and set up a back pressure of heated gases.

Fifth, we will inspect our radiator to see if any obstructions have stopped the water passages thereby interrupting or stopping circulation of the cooling waters.

Sixth, we will inspect, if we have mechanically forced circulation, our circulating pump. It may be defective or entirely out of commission.

Seventh, we will inspect our fan belt. It may be broken or may be too loose and slipping on the pully.

Eighth, we will inspect our lubricating system. It may be our engine is not getting sufficient lubrication.

Now that we have found the trouble and corrected it, we have a good pulling engine and we open the throttle and let our car ramble. But presently the engine develops a peculiar hissing.

Now there are just Six causes which may produce engine hissing.

First, we will inspect our spark plugs for, in all probability, we have a broken spark plug.

Second, we will see if any relief cock or priming cup valve is open, or if our spark plugs have priming device, we will look for leaks in the same.

Third, we will inspect our cylinder head gasket to see if it is properly fitted. It may be leaking.

Fourth, we will inspect our exhaust pipe connection to see if a loose joint is leaking.

Fifth, we will inspect the joint fittings on our intake manifold for any possible leaks.

Sixth, if we are forced to make the final investiga-

tion, we will inspect our cylinder walls for a scored cylinder.

Having located and quieted this objectionable noise, (unless we find a scored cylinder, in this event we will need to take the car to the garage) we are again spinning along the road but, now our engine develops a knock and it annoys us and may damage our engine.

We have, in this case, just Ten sources of trouble to investigate.

First, we will inspect the spark advance rods. They may be improperly adjusted and we can lengthen or shorten them, as may be required for proper advance of spark.

Second, we will inspect for carbon deposit in our engine.

Third, we will inspect our carbureter adjustment. It may be too rich.

Fourth, we will see if any nut has worked loose resulting in a loose bearing.

Fifth, we will see if we have a worn bearing in the engine causing the knock.

Sixth, we will see if we have a loose flywheel.

Seventh, we will see if there are loose cylinder holding bolts, which very often causes an engine to knock.

Eighth, we will see if we have an overloaded engine. If we overload our car we may expect our engine to knock.

Ninth, we will inspect the carbureter float to see if it is leaking or water logged. If a cork float, we must dry it thoroughly and coat it with shellac. If a metal float, we must be sure it is free of gasoline and dry, then solder the leak.

Tenth, we will inspect the priming pin spring to see if it is weak. Remove the spring and stretch it to make it stronger.

Now that we are well on the road and have a smooth running, good pulling engine and know exactly how to locate and correct any kind of engine trouble, I will let you take the wheel. But listen: There will, or may, be times when other troubles may develop, such as the engine smoking, explosions in the muffler, overheated exhaust pipe and etc. But such things are rare and usually unimportant and should give no alarm whatever. However, you will be able to quickly detect the cause of trouble and correct the fault.

As a driver you will meet with many car troubles, usually called chassis troubles, but you are to develop Auto Sense and thereby easily master every trouble.

Now; Wait a minute! The makers of your car have furnished you with a book of instructions and

you get yourself familiar with the detail of the entire contents of that book.

Also study Auto Sense till you dream it, then you will be able to go all the way and back again in your car, any time and to any place.

Always before making any drive look your car over and inspect it. This requires only three to five minutes time and may save a life and much money. Enough said. Start your engine. Ah! She's off at the first slight cranking. Now throw out your clutch and engage your low gear. O, it will not engage; Don't race your engine. Never race your engine.

Don't try to engage a gear when it will not engage freely.

Gently try the reverse. Now let your clutch in slightly. Enough. Now to low. Good. Now to second. Now to high. Fine.

For goodness sake! Get that frozen corps look off your face! You aren't driving a sulphur wagon to Hades. It's a pleasure car you are driving, so look pleasant. Relax! Do not labor so at the wheel. You are not boring post holes in dry ground with a dull auger. Imagine something funny to take the excessive tension off your mind. Think you see a would-be farmer, just moved out from the city, grinding his wire stretchers. That couldn't be any more silly than it is for you to try to keep this car in the road. No. You don't steer a car to keep it

in the road. You steer it to keep it from leaving the road, only at your will.

When you drove the old family horse did you yank him from one side of the road to the other or, rather, didn't you give him the line as long as he kept the road. Just so, imagine your right and left hands placed as they are on the wheel to hold the right and left line, and if old Dobin starts out of the road, gently remind him, by a slight pull on the line, that you want him to keep the road. Now that's just fine. But listen, don't swing out so far on the next corner as you did this one. Turn them just as short as the road bed permits you to and always slow down.

You say, it looks like one could turn a larger circle with more safety. Just so. But the illusion is, you cannot make the larger circle. It has to be built into the road. You swing out to describe the larger circle then, must essentially, cut your car sharply to get back into the road.

But these are of minor importance in slow driving but may easily result in a serious accident in fast driving.

However, as we are not giving driving lessons, only by suggestion, we will not go into detail but: Say we sure did go into that chuck hole. Slow down for those road pits. What are you stopping now for? I see; the engine is running, the clutch in and the gears in mesh and our car standing still. Kill the engine. Now we have either sheared or broken

something in the our power transmission. It's most apt to be just one of two things. We have a broken axle or we have sheared a key. Jack up one of the rear wheels. Throw the car in gear with the engine standing. Turn the wheel and if the engine turns then jack up opposite wheel and it will be found to revolve freely without turning the engine over. This indicates which side is disconnected. Remove the hub cap and if our trouble is a sheared key in the wheel hub we may put a wrench securely on the nut which holds the wheel on the axle and wire the handle of the wrench securely to a spoke in the wheel and thus drive our car on its own power to the garage. If any thing more serious than this has happened we will have to be pulled in.

Now we will presume we are on our way once more and, Look out! Too late now, don't race your engine. One wheel is deep in the mud and spinning while the other wheel stands still. Kill your engine. We could possibly find rails, or posts, or boards and pry the wheel up and give it traction. But let us have Auto Sense. The differential is a slacker and rather than take the strain it spins the wheel of least resistance. Disconnect the emergency brake rod from the wheel that has firmer traction. Now slightly set the emergency brake on the wheel in mud, or deep snow, as the case may be. Start the engine. Put 'er in low and out we go.

Say, that sure is some hill ahead of us. Better make a good run for that. Well, well, you made a good run but, Shift quickly! Too late! You killed

your engine. Hold your car with your emergency and start your engine. It fails to start. (We will now suppose we have a gravity feed system.) Look for low line of gasoline. Yes, too low in the fuel tank to feed to the carbureter. We nearly went over the top and if the engine could have maintained sufficient speed the suction would have drawn enough fuel. Now we shall have to back down the hill and then back up the hill and it is very dangerous to back down a long steep hill with an ugly ditch on either side and, it puts an undue strain on the reverse mechanism to back up such an awful hill. Well we could walk some where and borrow or buy some gasoline, or we could phone from some house some where and have the garage send us out some gasoline, or we might hire some farmer's team and pull the car over the top, then we would have enough gasoline to go the eight miles to town. Now let us here have Auto Sense.

If myself, or some other person could always be with you, I would show you how to turn this trick in the quickest and easiest way but, since you may be caught alone you will need to know how to turn it by yourself. Make a peg, of a match or any piece of wood, that will fit tightly in the vent hole of the filler cap on top of the gasoline tank. Now take your tire pump and hold the open end of the air hose tight over the vent hole and pump twenty-five or thirty good full strokes of air into the tank, slipping the peg stopper quickly into the vent hole. Crank your engine and go over the top. You have pres-

sure feed. Thank you sir. But wait a minute. Be sure to remove the peg from the vent hole when you have topped the hill. If there should be two of you, then you will not need the peg. One run the pump and the other the engine.

Now the author could go on writing volumes of interesting things in the line of Auto Sense but most of them you would never need, many of them will occur to you and some of them you already know.

I have tried to give a clear and concise understanding to the reader of the more important and essential things which the automobile driver will most frequently need. These things the automobile driver should know and if you will carefully and frequently consult the pages of this little book and thoroughly familiarize yourself with its contents you will find that this, plus actual practice, will save you hundreds of dollars in garage bills which you may pay to yourself instead of paying the other fellow.

And now, there is your home. Wouldn't it have been an awful thing if we really had had all the trouble we have imagined? But will it not be a great thing, in the event you ever do have any of these troubles, that you will know just what to do, and how nice to drive and handel with perfect safety, your own car. Now didn't that turn in to your gate just like old Dobin? And look! It stops for the gate to be opened! Never mind; keep the wheel; I will open it. Now you see, you can make it do any thing you want it to. Did you say, Except to pay the gasoline

bills? Listen, the shoe leather you would wear out walking to town would cost more money than the gasoline you would burn by riding in your car to say nothing of your loss of time. But on the road somewhere, you suggested you would give me a definition for Auto Sense. Let's have it. Good! Good! Thank you.—Auto Sense is Horse Sense in a Mechanical form.

ARTICLE 1.

Testing Batteries.

(1) Dry Cells.

The voltage of a primary dry cell should be from one and four one hundredths to one and one half volts.

The amperage of a primary dry cell should be twenty five to fifty amperes, according to size. No. 6 should show twenty-five to thirty amperes.

A dry cell is said to be discharged or exhausted when it fails to show seven amperes.

A dry cell may show nearly full voltage when it is giving out very little current.

Extra mileage may be secured by connecting batteries in series multiple or change of vibrator adjustment.

The terminals should be gone over carefully and inspected for loose or broken cell connectors.

Any weak cell must be taken out of the battery.

Dry cells should be renewed every sixty days.

When testing the cells with an ammeter it should be done quickly because the ammeter short circuits the cell.

Each cell should be tested separately.

(2) Storage Battery.

The voltage of a fully charged cell should be two and one half volts.

The cell is down or discharged when the voltage falls to one and eight one hundredths.

The proper way to test a storage battery is to test the specific gravity (density) of the solution, or electrolyte in each cell with a hydrometer.

The reading on a fully charged cell should be one and two hundred and eighty thousandths.

Reading, one and two hundred and fifty thousandths is eighty per cent of full charge.

Reading, one and two hundred and twenty-five thousandths is sixty per cent of full charge.

Reading, one and two hundred thousandths is forty per cent of full charge.

Reading, one and one hundred and seventy-five thousandths is twenty per cent of full charge.

Reading, one and one hundred and fifty thousandths the battery is exhausted or discharged.

Keep battery securely fastened in place and keep the battery compartments wiped clean and dry.

See that terminals are tight and do not permit an open flame near the battery.

See that the electrolyte is kept at proper height (over top of plates) and use only pure water.

A storage battery should be charged once every two months, whether it is used or not.

Care should be taken to remove all verdigris or sulphate from the battery terminals.

ARTICLE 2.

Inspecting Wiring and Switches.

All wiring should be inspected for worn, broken, cracked, torn, burned or otherwise faulty insulation.

The fuse wire on a resistance coil should be inspected to see if it is burned or broken.

The wiring should be inspected for broken strands or broken places in the wire.

To find which, if any, strand is broken in a cable,

use a small compass on each separate strand with a battery attached to other end of cable. If any strand is broken it will not attract needle of compass.

Inspect carefully all terminal connections for dirty, grasy or stranded ends or parts.

Ground wires should be inspected for loose, dirty, rusty or fautly ground connections.

All switches should be thoroughly overhauled but do not disassemble a switch only one part at a time, carefully putting each part back to place before removing another.

Never "think" a switch is O. K. if its inspection falls in the line of trouble shooting. Inspect it.

ARTICLE 3.

Inspecting and Testing Magnetos and Dynamos.

(1) The Dynamo.

A dynamo differs from a magneto chiefly in the field magnets. Its parts are: Commutator end housings, Drive end housings, Complete armature, Commutator, Insulating process, Field coils, Generator bearings, Motor bearings, Brush holders, Automatic cut-out, Ignition attachment and Generator drive.

(2) The Magneto.

The magneto is classified by manner in which the

current is generated, those having rotating armature and those having stationary armature with revolving inductors.

Magnetos may be divided again in considering the kind of current generated.

These are low tension current and high tension current.

There may be a further division in considering, true high tension current and high tension current with self contained coil, and high tension with separate coil.

Still another class is known as inductor magnetos.

In a low tension system all the electrical principles involved are very simple while the mechanically applied principles are highly complicated.

The high tension system is exactly opposite to this in that it is very complicated in its electrical functioning but simple in the mechanical application of its working principle.

The elements of a low tension circuit are: A source of current supply, (Primary battery, accumulator, or, low tension magneto.) primary induction coil, (when a battery is used,) an igniter, a switch for breaking the circuit, (an additional switch to alternate between the battery and the magneto, when both are used,) and connecting wires.

The necessary thing in low tension ignition is to

secure extreme rapidity in the "brake" or separation of the contact points.

Inspect the following parts of the low tension magneto: Interrupter, high tension leads to cylinder, high tension distributer disc, distributer wipe contacts, secondary ground on metal of engine, distributor rings of primary circuit and timing bell crank. (This bell crank may be worn.)

Inspect the following parts of the high tension magneto: High tension collector ring, carbon brush for high tension current, spring contact for conducting the high tension current, distributor carbon brush, distributor disc, central distributor segment, high tension terminals, interrupter, or circuitbreaker, low tension brush and inspect the timer, or commutator, or distributor for wabbling or lost motion in bearings, for cracks or breaks in insulating rings and for poor ground contacts.

ARTICLE 4.

Vibrators and Coils. Inspecting, Testing and Adjusting.

Coils require about six volts to operate them for proper working.

A coil using a resistance unit may be stepped up on a weak battery by changing terminal of battery lead on the coil to top of the resistance unit, cutting out the resistance.

A slight ticking is usually detected inside a coil, (using a sonoscope,) if the coil is broken down.

The vibrators of a multi-unit coil should be tuned to the same vibration.

Vibrators should be screwed down to about 1-3 ampere current.

One-half turn of the adjusting screw at the coil will increase the current 1-2 to 1 and 1-2 amperes.

The vibrator spring should be adjusted so the hammer at the end of spring will stand, normally, 1-16 in. above the end of coil.

The platinum points on both the trembler spring and adjusting screw should be smooth and have positive contact.

The tension of the vibrator spring should not be too light or too heavy, but should make a sharp, buzzing sound when contact is established at the timer.

The adjusting screw should be tight in the vibrator bridge and when the proper spring tension is obtained, the regulating screw should be firmly fastened to prevent movement.

If the vibrator operates satisfactorily, but there is a brilliant spark between the vibrator points, or a heavy, bluish spark, and a poor spark at the spark plug, and no change from adjustment, it is evidence that the coil condenser is punctured.

This would mean a short circuit at condenser and will require a new coil.

Time required to saturate the coil, make the break, (vibrator) and discharge the core, is five thousandths of a second.

The failure of one coil unit will be due to: a defect in the coil itself, in its vibrator, in the wire to the timer or in the timer.

The failure of all the coils will be due: to the battery, or to the wires from battery to ground, or wires from the battery to the switch, or in the switch, or in the timer being entirely out of commission.

ARTICLE 5.

Timing. Inspecting and Adjusting.

(1) Intake, or, Inlet Valve. Opens when crank is eight degrees past top dead center and closes when crank is thirty-eight degrees past the lower dead center.

Inlet valve opens and closes late.

(2) Exhaust Valve. Opens forty-six degrees before crank reaches the lower dead center and closes fifteen degrees past the upper dead center.

Exhaust valve opens early and closes late.

If the diameter of flywheel is 18 in. the Inlet Valve

opens late 1 and 1-4 in. top center, and closes 5 and 31-32 in. past bottom dead center.

If diameter of flywheel is 18 in. Exhaust Valve opens early 7 & 15-64 in. bottom dead center and closes late 2 & 23-64 in. top center.

Timing Ford Valves. Intake Valve opens with the piston 1-16 in. down from top center and closes 9-16 in. after the piston has reached bottom center. The distance from the top of the piston to the top of the cylinder casting should measure 3 & 1-8 in.

Exhaust Valve opens when the piston reaches a point on its travel from 5-16 in. to 1-4 in. before lower dead center, on 3rd stroke. The piston position, or distance from the top of the piston head to the top of the cylinder casting at the time the exhaust valve starts to open is 3 & 3-8 in.

The Exhaust Valve should close on top center between 3rd and 4th strokes.

The piston top at this time is 5-16 in. above the cylinder casting. The clearance between the push rod and the valve stem (Ford) should never be greater than 1-32 in. nor less than 1-64 in.

Firing Order. Ford and Hupmobile, 1-2-4-3.

Usual Practice, Four cylinder engines, 1-3-4-2.

Six cylinder engines, 1-4-2-6-3-5.

Eight cylinder engines, 1-4-5-2-7-6-3-8.

ARTICLE 6.

Circuitbreaker, Or, Interrupter. Inspecting and Adjusting.

(1) Bosch Magneto-Breaker points should be perfectly flat and smooth, and when fully open should be about Fifteen thousandths of an inch clearance.

(2) Simms Magneto—Troublesome parts; Distributer arm and segments dirty. Contact breaker should open one sixty fourth of an inch.

(3) Atwater Kent Ignition System—Normal gap of contact points should never be closer than ten to twelve thousandths of an inch.

(4) Remy System—Circuit-breaker points should be, at the breaker gap fifteen to twenty thousandths of an inch. The maximum may be twenty-five thousandths of an inch.

(5) Dixie Magneto—Gap in Circuit-breaker twenty thousandths of an inch.

(6) Heinze Magneto—Circuit-breaker points should be adjusted to open twenty thousandths of an inch.

(7) Where no specific instructions on magneto is available the Circuit-breaker points may be adjusted twelve to fourteen thousandths of an inch at maximum opening.

ARTICLE 7.

Spark Plug Gaps. Inspecting and Adjusting.

(1) Remy Magneto—Spark Gap between the electrodes of the plug should be twenty to twenty-five thousandths of an inch.

If the engine misses when running idle or pulling light, the gaps should be made wider. If engine misses at high speed, or when pulling heavy at low speed, the gaps should be made closer.

(2) Heinze Magneto—The spark gap in the plug should be adjusted to a minimum of twenty thousandths of an inch and a maximum of twenty-five thousandths of an inch.

(3) In adjusting the spark gap of a plug, it should be remembered that it requires from three to five thousand volts for sparking pressure in the air, while in the cylinder under a compression of four or five times atmospheric pressure, it reqiures an electrical pressure of from ten to twenty thousand volts.

(4) In usual practice spark plug gaps should be from fifteen thousandths of an inch to one thirty-second of an inch open, depending on the ignition system and compression of the fuel charge.

ARTICLE 8.

Carbureters. Testing and Adjusting.

The author of Auto Sense could write a lengthy article on Gasoline and Carbureters. He could go into the detail of all the chemistry involved, as his grades of 100 per cent proficiency show. But when the reader had finished, the subject would be blanketed with mysteries, and you would still believe it was too deep for any one but experts.

If you take food into your stomach and by the mysterious process of digestion it is convreted into blood and bone and muscle of your body, then you become acquainted with the fact that your stomach is an important organ of your body and must function in order to the health of your body.

Now let us suppose the carbureter to be the stomach of our engine and the gasoline to be the food, and now if we let the mixture represent the state or degree of digestion we will easily understand the principles involved in carburation.

Our carbureter (stomach) must properly mix (digest) the oxygen in the air with the carbon and hydrogen in the gasoline and then our system must function to effect the chemical combination of these elements and we shall have combustion.

Now there is no need for us to set down here a lengthy technical data as to the proportions of the mixture.

If you eat too much you may have indigestion and if you do not eat enough you will have a starved body.

Now we are going to adjust a carbureter having a gasoline adjustment and an auxiliary or secondary air adjustment. Turn the needle valve down till it is closed; that is, turn it clock-wise just as you would turn a screw down into a board. Now this is to prove to you that it is closed and to show you where to begin. Now open the needle gasoline valve one and one-half turns. Leave the high speed adjustment, or auxiliary air adjustment closed till you are through with the fuel adjustment.

Now start your engine and with it idling about two hundred and fifty revolutions per minute, turn your fuel adjusting needle to opening or closing till you get the best results.

You can easily tell by the performance of your engine.

Now open the auxiliary air adjustment and accelerate your engine and continue opening slowly and continue accelerating the engine till the engine backfires or misses, then turn the air valve back to closing slightly till the backfiring or miss is "killed."

In adjusting carbureters from flame colors, if no motorscope is available, remove the exhaust manifold and adjust and observe for these indications: At the lower and medium speeds the color of the flame should be a dark blue, verging upon violet.

For other speeds up to normal rated speed of the engine, the color should be a somewhat lighter blue, but should at no point loose its decided blue tinge. A yellow tint in the exhaust denotes too little gasoline in proportion to the amount of air supplied. Red flame indicates too much gasoline. If the flame colors fluctuate from yellow to red and no carbureter adjustment will correct the defect it indicates a faulty nozzle action.

Adjusting Ford Engine Carbureter. The stock equipment of most all Ford cars to 1919 presents a Holley Carbureter.

To adjust this carbureter you simply turn it down, clock-wise, that is, just as you would turn a screw downward into a board, till you close the needle valve. This is to show you that the valve is closed and to give you a starting point to adjust from. Now turn opposite to opening one full turn, (If cold weather, one and one-half turn.)

This is your starting or cranking adjustment. Now start your engine and let it warm up nicely, then turn the fuel valve slowly down to closing, with the spark and throttle levers up to top of sector, till engine idles nicely.

This is your idling adjustment. Now retard your spark half way down on the sector and accelerate the engine with the throttle, slowly turning fuel valve to closing till engine backfires, then turn slightly back to opening till the engine acceleartes with-

out backfiring. This is your road and high speed adjustment.

ARTICLE 9.

Valve Lift. Inspecting and Adjusting.

(1) Studebaker Four and Six—Push rod clearance at valve stem lift should be three thousandths of an inch.

(2) Buick—Four to five thousandths of an inch.

(3) Ford—Not greater than one thirty second nor less than one sixty fourth of an inch.

(4) For all car practice, in the absence of specific instructions, from six to twelve thousandths of an inch.

PUT PEP IN YOUR FORD

Wright's Pep Manifold Vaporizer for Ford Cars gives three to six miles more per gallon off gasoline.

Increases the power of your engine from two to five horse power over what is usually developed.

Makes the engine run smooth when laboring under a heavy load.

Keeps all the spark plugs clean all the time.

Provides priming of the engine for easy cranking.

Provides each intake stroke with a perfectly balanced mixture of pure dry gas.

Prevents condensation in the intake manifold and makes every cylinder hit regularly.

PEP prevents the formation of carbon in the cylinders and keeps the back pressure off the pistons by preventing loading or choking of the muffler with soot.

PEP is automatically transformed into an air brake when throttle is fully closed and clutch is left in and will hold your car to a safe speed down most any hill, at the same time cleansing each cylinder with fresh air and preventing excessive heating of the cylinder walls, thus using much less cylinder oil than is usually required.

PEP makes your car ride easy and handle easy by

imparting a soft floating like motion to the car through each power stroke instead of the usual jerky wave like motion caused from unbalanced mixture of the fuel charge.

PEP puts the power punch into the piston, kills all smoke and offensive odor of burning gasoline and absolutely ends ninety per cent of all engine trouble.

PEP makes the exhausting ring clear as a bell and causes your engine to respond with life like performance at each opening touch of your throttle.

PEP will put your car up all the hills in high and make it show more speed and acceleration than most of the big sixes and when they "honk" for you to lay over PEP will save you the embarrassment of eating their dust.

PEP sells without sales agents or dealers talk or argument.

Send no money; Sign no contract: Simply drop us a line if you want to try a PEP.

We will send one PEP to any address, upon request for free trial, and let you be the judge and the jury as to the merits of this wonderful invention.

Nothing to do but to change intake manifolds, take yours off and put PEP on.

If after a reasonable trial, not exceeding thirty days, you are satisfied of the real merits of PEP and want to keep it on your car, send us your check for

the purchase price, now $5.00 or, what is better for you, send us your check for $3.85 and send us by parcel post your old manifold as we pay $1.15 each for the old manifolds, using them as one of the parts in the construction and assembly of our PEP manifold vaporizer.

If after a reasonable trial you are not satisfied of the real benefit to your engine which we claim and beileve you will receive then simply return it at our expense.

Not more than One PEP will be sent for trial to any one person hence if two or more neighbors wish to try them they must make separate and individual request.

Address:

THE J. R. WRIGHT ENGINEERING WORKS,
1301 Tinsman Avenue, Trenton, Mo.

AUTO SENSE

I.

Index to Special Articles.

AUTO SENSE

II.

Index to Troubles.

AUTO SENSE

Index to Troubles Continued